Quantum field theory　**MENU**

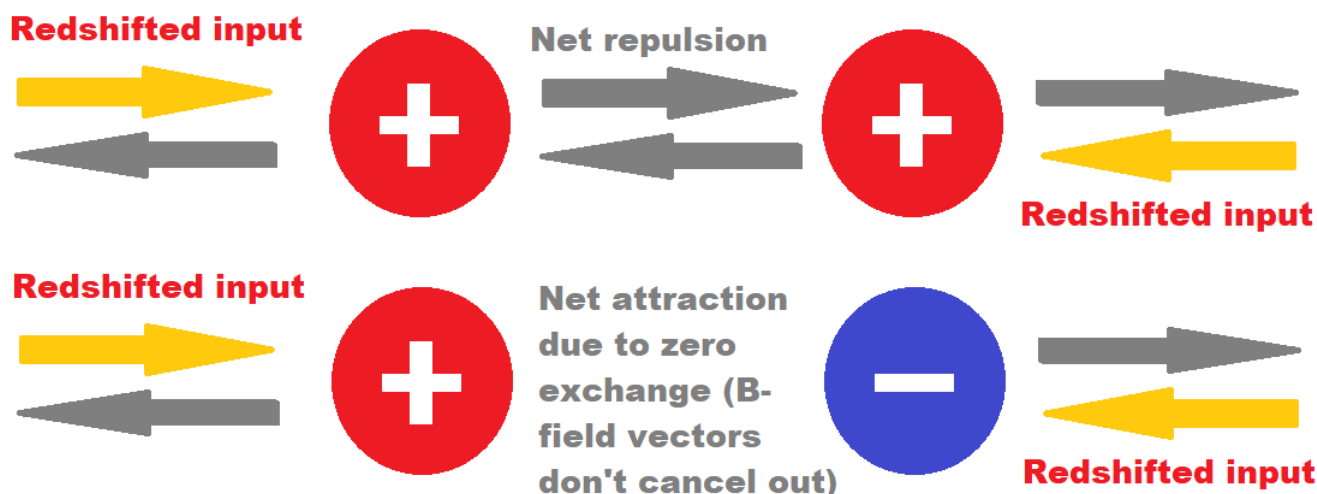# Finally some good news – Ed Witten superstringer has retired

__FEBRUARY 27, 2023FEBRUARY 27, 2023__　·　*Posted in*　__ABOUT__

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JRCE: improved from http://vixra.org/abs/1111.0111 Fig 21 on p28, etc.

"I just noticed that last semester Edward Witten was teaching Physics 539 at Princeton, a graduate topics course. Since he's now past the age of 70, at the IAS he is officially retired and an emeritus professor (the IAS is the only place I know of in the US with retirement at 70, presumably since it is a non-teaching institution)." – PW, *Physics With Witten*, www.math.columbia.edu/~woit/wordpress/?p=13402 (http://www.math.columbia.edu/~woit/wordpress/?p=13402)

Why similar charges repel and opposites attract
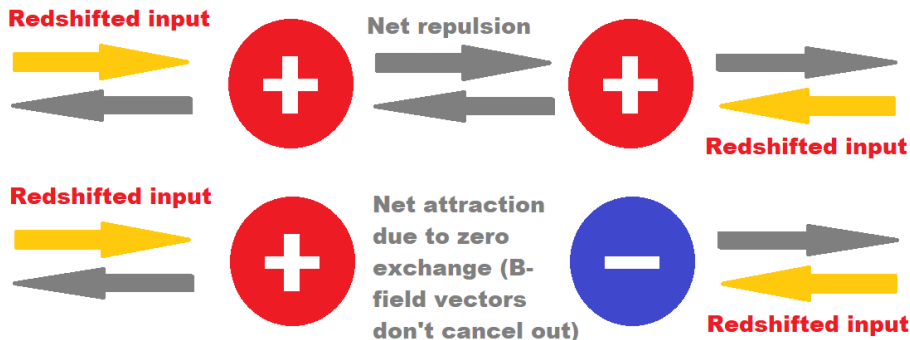
Field quanta AROUND leptons manifest for all purposes "electric charge", but like an duck that quacks being taken for a fake duck, quacks falsely discredit charged field bosons, saying their B (magnetic) fields necessitate mass. Nope, because B's cancel!

SOURCE: improved from http://vixra.org/abs/1111.0111 Fig 21 on p28, etc.

(https://nige.files.wordpress.com/2023/02/why-similar-charges-repel-and-opposites-attract-1.png). In other news, I asked PW if he could make available PDFs of his 1980s papers, e.g. his research published (behind firewalls) in Physical Review Letters (https://www.math.columbia.edu/~woit/topologicalcharge-prl.pdf) and Nuclear Physics (https://www.math.columbia.edu/~woit/ssym-nuclphysb.pdf), and he kindly emailed me he has put them up hidden away under "For some really, really old things" at https://www.math.columbia.edu/~woit/ (https://www.math.columbia.edu/~woit/), namely here (https://www.math.columbia.edu/~woit/topologicalcharge-prl.pdf), here (https://www.math.columbia.edu/~woit/ssym-nuclphysb.pdf), together with previously unavailable stuff here (http://www.math.columbia.edu/~woit/chernsimonslattice.pdf) and here (https://www.math.columbia.edu/~woit/tqtandrepthy.pdf). The key ones for improving understanding of Standard Model symmetries: Supersymmetric Quantum Mechanics, Spinors and the Standard Model (https://www.math.columbia.edu/~woit/ssym-nuclphysb.pdf) (Nuclear Physics B393 (1988) 329-342) and Topological Quantum Theories and Representation Theory (https://www.math.columbia.edu/~woit/tqtandrepthy.pdf) (conference proceedings 1989). Woit from my perspective (https://nige.wordpress.com/2022/12/27/edward-a-schuert-for-understanding-the-path-integral/) is conservative in physics, not going in for 10/11 dimensions and their landscape of possibilities. This doesn't of course mean I agree with his attacks on string theory (that great humanism branch, Machiavellianism *aka* realpolitik makes it clear: if you don't like the king, you need to *replace the king,* not make enemies by complaining to no good effect without doing anything about the problem that really sorts it).

One can do four-dimensional complex geometry by identifying $\mathbb{C}^4$ with 2x2 complex matrices

$$(z_0, z_1, z_2, z_3) \leftrightarrow z = z_0 1 - i(z_1\sigma_1 + z_2\sigma_2 + z_3\sigma_3)$$

Three real forms are

- (2, 2) signature inner product: $Spin(2, 2) = SL(2, \mathbb{R}) \times SL(2, \mathbb{R})$, using $g_L, g_R \in SL(2, \mathbb{R})$.
- (3, 1) signature inner product: $Spin(3, 1) = SL(2, \mathbb{C})$, using $g_R = (g_L^\dagger)^{-1}$. This is Minkowski space-time.
- (4, 0) signature inner product: $Spin(4, 0) = SU(2) \times SU(2)$, using $g_L, g_R \in SU(2)$. This is Euclidean space-time.

- Use twistor geometry to get not just an $SU(2)_L$ internal symmetry but the full electroweak $SU(2)_L \times U(1)$ electroweak internal symmetry, with the imaginary time component of the vierbein behaving like a Higgs field.

- There is not just an $SU(2)$ internal symmetry, but also a $U(1)$, given by the complex structure specified by the point in the fiber. This complex structure picks out a $U(2) \subset SO(4)$, the complex structure preserving orthogonal transformations of the tangent space to the point on the base S^4. This is the electroweak $U(2)$ symmetry, to be gauged to get the standard electroweak gauge theory.
- If one lifts the choice of vector in the imaginary time direction up to PT, it transforms like the Higgs field: it is a vector in $\mathbb{C}^2$ (using the complex structure on the tangent space given by the point in the fiber). The $U(2)$ act on this $\mathbb{C}^2$ in the usual way. Each choice of Higgs field breaks the $U(2)$ down to a $U(1)$ subgroup, which will be the unbroken gauge symmetry of electromagnetism.
- Exactly the internal symmetries of the Standard Model occur.
- The intricate transformation properties of a generation of Standard Model fermions correspond to a simple construction.
- One gets a new chiral formulation of gravity, unified with the SM.
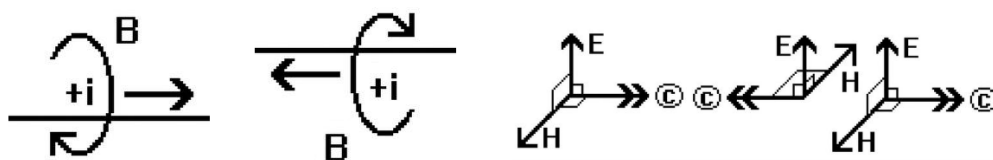- Conformal symmetry is built into the picture in a fundamental way.

HIGHLIGHTS OF WOIT'S TWISTOR UNIFICATION THEORY

Fig 1 from earlier post linked here: https://nige.wordpress.com/2022/02/17/woits-euclidean-twistor-unification-slides-at-the-algebra-particles-and-quantum-theory-seminar-feb-14-2022/

(https://nige.wordpress.com/2022/02/17/woits-euclidean-twistor-unification-slides-at-the-algebra-particles-and-quantum-theory-seminar-feb-14-2022/)

My issue with Woit's model building is that he makes the populist uncritical implicit assumption that the electroweak symmetry group SU(2) X U(1) is rock solid because it appears simple, ancient, and beyond issue. The SU(2) weak symmetry certainly is. The problem, ironically, is the very old U(1) electrodynamics concept being used in the SM, which causes a lot of epicycles that are unnecessary, e.g. mixing angles. Actually U(1) is hypercharge and only becomes electromagnetism after a partial ad hoc mixing with SU(2), hence the electroweak unification is suspect. Not the SU(2) weak interaction, whose vector bosons and interactions are well modelled by that theory. Nobody seems to take seriously the issue that SU(2) is a better model for electrodynamics than U(1). So now you have a cleaner electroweak unification with two SU(2) theories, one in which the vector bosons acquire mass in such a way the force is chiral (weak interactions), *and the other (electrodynamics) has massless vector bosons which – because those massless SU(2) electrodynamic charged vector bosons would have infinite (impossible to propagate) magnetic self-inductance – reduces that theory to the illusion of U(1) because you only get to see what appears to be uncharged massless vector bosons*:

CHARGED MASSIVE VECTOR BOSONS CAN PROPAGATE, WHERE THERE IS AN EQUAL FLOW IN BOTH DIRECTIONS TO CANCEL OUT THE MAGNETIC VECTORS

NOTE THAT THE CURLS OF THE MAGNETIC FIELDS CANCEL, SUPERIMPOSED

(https://nige.files.wordpress.com/2023/02/why-similar-charges-repel-and-opposites-attract2-1.png) Fig. 2 reference: https://vixra.org/abs/1111.0111 (https://vixra.org/abs/1111.0111) (Fig 21 on p28), see also https://vixra.org/abs/1305.0012 (https://vixra.org/abs/1305.0012). Basically, dark energy produces gravity (https://vixra.org/pdf/1305.0012v2.pdf) and you use a simple model for dark energy/gravity, the charge of which is the Higgs "boson". See also Massless Electroweak Field Propagator Predicts Mass Gap, a 2014 paper which very simply resolves the mechanism for mass and proves this! (https://vixra.org/abs/1408.0151) If nothing else, this proves that simple mechanisms in QFT, a total taboo thanks to obscurantists. I emailed Woit some suggestions as a vote of thanks for his contributions:

Hi Dr Peter Woit,

Thanks for making available these papers. I don't think you're going to reply to this, but maybe there is no harm in sending you one email about a non-SUSY approach to unification.

I notice you have a comment on the latest Not Even Wrong post asking you about the 3 S.M. running couplings appearing to converge near 10^{15} GeV for "unification" and you give a reply about higher order corrections involving loops in vacuum polarization for strong forces.

Just supposing you want rapid progress in the unification of SM forces in QFT, not just to play devil's advocate against the mainstream groupthink herd. Consider field energy conservation: quarks have less electric charge than leptons. The electric field extends to infinity because its vector bosons are massless, but for the strong and weak fields the vector bosons are massive with a short range.

Take the simplest example to analyse: the Omega minus, composed of three strange quarks, each with -1/3 the electric charge of the electrically charged lepton, electron/muon/tauon.

Now consider the vacuum polarization: if strong interactions and associated color charge are an emergent property of having 2 or 3 particles in proximity, a simple way to understand this, for the Omega minus, is to imagine 2 or 3 particles with unit electric charge like a charged lepton: the only they can exist in proximity without violating Pauli's exclusion principle is to have an extra quantum number for color charge, which means a gluon field that contains energy.

If you can integrate the total gluon field energy per strange quark over radial distance – which shouldn't be that difficult because although the coupling gets bigger at much higher energy, that corresponds to very tiny distances with very small volumes since volume is proportional to the cube of the radius – so you're multiplying a large uncertain coupling controlled energy density for the field by an extremely small volume which goes to zero as the coupling gets large near zero radius.

(The mainstream "unification" approach whereby radii from a particle core are inverted and called "energy scale" seriously obfuscates the whole issue, particularly as the volume gets smaller as the cube of the radius and thus the cube of the energy scale!)

Therefore, if "unification" between quarks and leptons is real, that calculation should indicate the total gluon mediated color field strong interaction energy around a strange quark in Joules. You then simply compare that result to the energy in the electric field of the charged lepton. If you can't decide what small radius to use, don't worry, simply assume the total electric charge field energy of an electron is its rest mass energy 0.511MeV.

If the former is 2/3 of the latter, this is evidence that the "unification" theory for the transformation between leptons and quarks is equivalent to electric charge field energy being converted into strong colour charge energy, this explaining why quarks have fractional charges, I.e. a strange quark has 1/3 of the electron's electric charge because 2/3 of the electric charge energy is turned into colour charge energy.

There's still plenty of fun here, e.g. calculating the energy in the weak (W/Z mediated) field of a particle, and looking at different quark's charges (beyond the strange quark).

Kind regards,

Nigel